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surely taken that the reader at the end is convinced that the results derived from so many facts must be well founded.

In 1837, in a short paper on the " Formation of Mould," the author showed "that small fragments of burnt marl, cinders, &c., which had been thickly strewed over the surface of several meadows, were found, after a few years, lying at the depth of some inches beneath the turf, but still forming a layer." This was due " to the large quantities of fine earth continually brought up to the surface by worms in the form of castings." This subject has been faithfully followed up through a period of over forty years.

After describing the structure and habits of the earth-worm, Darwin shows that they burrow both by pushing away the earth on all sides, the pharynx being, as Perrier had shown, pushed forwards into the end of the head, causing it to swell out, and thus push the earth away on all sides, while also the worm swallows the dirt, which passes through the body. In this way worms may penetrate to a depth of from three to eight feet. By their great numbers and continued activity earth-worms bury small, and often great stones left on the surface. In many parts of England it is estimated that a weight of more than ten tons of dry earth annually passes through their bodies and is brought to the surface on each acre of land; so that the whole superficial bed of vegetable mold passes through their bodies in the course of every few years. Moreover they triturate and thus disintegrate particles of rock, and thus aid in the denudation of land. By their action ancient earthworks and tumuli are lowered, and old ruins, pavements and stone walls are either buried or perceptibly lowered, and thus the humble earth-worm acts in the end as a not unimportant geological agent.

THE MICROSCOPE IN MEDICINE, BY LIONEL S. BEALE, M.B, F.R.S.[1]—This is the fourth edition of a well-known and valuable work, by one of the most practiced microscopists of the United Kingdom.

The introduction consists of an able plea for encouragement and assistance in the scientific investigation of disease, and is followed by nearly 200 pages devoted to a description of the apparatus necessary for the examination of objects of clinical importance, the practical operations required for their demonstration, and the methods of recording the appearances observed.

In this portion of the work full directions are given for hardening, boiling, freezing, rendering transparent or opaque, preserving, mounting, coloring, cutting sections, injecting, and other processes necessary for the examination of the various kinds of healthy and morbid tissues, both hard and soft, and the letterpress is aided by twenty-four plates.

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[1] *The Microscope in Medicine*, by LIONEL S. BEALE, M.B., F.R.S., Fellow of the Royal College of Physicians, etc., Fourth Edition, pp. 528. Illustrations more than 500, most of which have been drawn on wood by the author. London, J. and A. Churchill; Philadelphia, Lindsay and Blakiston.

The second and larger part treats of the microscopical characters of the simplest particles of tissues and of their demonstration; of structural elements and elementary parts in health and disease; of deposits from fluids, and of animal and vegetable parasites. After a chapter devoted to the living matter and cell-structure of organizms the author treats of lymph, chyle, blood and serous fluids, of medico-legal investigations, saliva, sputum, vomited matters, fæces, discharges of various kinds, and milk. Pus, animal poison or virus, contagium, and tubercle, are next considered, and the author's views of their nature fully stated; the urine, and urinary deposits and calculi, are next examined into, and the remaining portion of the work, except a short chapter devoted to human parasites, is taken up by methods of investigation of the various tissues and organs of the body in health and disease, and statements of the author's opinions of the nature of diseases affecting them.

In a field so broad as that covered by this book there is of course much room for difference of opinion. Dr. Beale devotes much of his space to theories of his own, more or less ably supported by argument; and to the disproof of rival theories.

His opinion upon the value of the microscopic examination of blood-stains in cases of supposed murder, based as it is upon the great resemblance of the red blood corpuscles of the carnivora, some ungulates, rodents, quadrumana and certain other mammals to that of man, and upon his own extensive practice, is entitled to great weight. He says, " I can hardly think that in any given case the scientific evidence in favor of a particular blood-stain being caused by human blood, will be of a kind that ought to be considered sufficiently conclusive to be adduced, for example, against a prisoner upon his trial." He, however, considers such evidence as of value in strengthening or weakening other circumstantial evidence.

Against all theories of disease that refer the contagion to germs of fungi or bacteria, Dr. Beale decides unhesitatingly and argues, in our opinion, almost convincingly. He does not by any means stand alone. Dr. Benjamin Richardson has long advocated very similar views, and although the adherents of the "germ" theory have of late years made a far greater show in print than their opponents, it has been through the remissness of the latter rather than on account of the powerful arguments of the former.

That bacteria, vibrios, etc., are found in abundance in all those diseases called zymotic, is undeniable, but it is also true, as Dr. Beale asserts, that " many things we eat contain them in countless multitudes. In the alimentary canal of infants suffering from a little stomach derangement, bacteria are often present in vast numbers * * * * many of the secretions may contain them without perceptible injury to the health, while hosts of them are invariably present in the fluids, and in and about the superficial cells of the mucous membrane of the mouth of all persons, even in the most vigorous health." All fungi and schizomycetes feed upon decaying organic matter, and therefore their presence does not prove that they are the cause of the disease. The assumption of a different species of bacterium to each disease is not warranted by our present knowledge of these low existences, and if, as our author asserts "the virulence of the virus decreases as the bacteria in it increase in number," the bacterium theory seems scarcely tenable. Dr. Beale asserts that he has never been able to discover a bacterium in pure vaccine lymph, and that those who regard the solid particles found in vaccine as bacteria commit the grave error of confounding the actual contagious "bioplasts," derived from the living matter of the cow, with bacterium cells, from which they differ visibly in the want of regular form and the absence of a cell-wall. Dr. Beale believes the contagium or virus of every contagious disease to consist of extremely minute particles of the *living* matter of the species infected by the disease. This contagium is "bioplasm" become poisonous, and "each kind of contagious bioplasm manifests its own specific actions, and only these." He admits, however, that such particles cannot, in the present state of our knowledge, be distinguished from healthy particles of the same size; and he also admits that it is remarkable that one form of disease has always been found accompanied by a specific organism that has not been found in any other.

May not the truth lie between the two opposing schools, and, although the great majority of diseases are caused by organic changes in the protoplasm or in the secretions (Dr. Richardson's theory) of the infected species, may not a few, especially those which are localized in their manifestation, be caused by microscopic organisms? We know that the entozoa sometimes produce positive disease, and that certain skin diseases are caused by acari—why then may not certain lower existences be poisonous, and cause some of the less common forms of disease?

Dr. Beale asserts that the pus corpuscle or globule has no cell-wall, and that "the bioplasm of tissue, being supplied with an increased quantity of pabulum, may give rise to pus." A too rapid multiplication, resulting in the formation of particles that have lost the power of forming tissue, is, in Dr. Beale's opinion, the origin of pus. Tubercle, he asserts, can be microscopically shown to consist of small protoplasmic masses of about the size of a red blood corpuscle, these particles are living, and grow, but more slowly than pus corpuscles, from which they differ also in their firmer consistence. Thus there is a tendency to heredity, yet tubercle may be developed by bad hygienic conditions in persons free from hereditary taint.

Morbid growths of a malignant, cancerous nature are by our author believed to originate "in the embryonic bioplasm found in connection with complex structures," yet he also thinks that "the cause of the cancer development operates at a period of time separated by many, many years from the period of the actual production of the cancer-cells, * * * * * even during embryonic life." Is the last belief, which is warranted by the often observed cancerous diathesis, consistent with the former?

It is greatly to be regretted that Dr. Beale continues to use the word "bioplasm" for the living formative substance of organisms, called by all naturalists and known to a large portion of the public as protoplasm. It matters not if the word has been, as Dr. Beale states, used improperly, the fact remains that those who use the word protoplasm, use it in exactly the same sense in which Dr. Beale uses "bioplasm," and nothing but confusion can result from the introduction of a new term.

"Protoplasm" was first introduced to the English public in Von Mohl's work "On the Vegetable Cell," translated in 1851, and was known in Germany several years earlier. The existence of detached particles of living matter, destitute of a cell-wall, and usually smaller than cells, does not, whatever Dr. Beale may assert to the contrary, disprove the cell theory, which receives such continued confirmation from the work of microscopists in all parts of the civilized world, that it ought not to be called a theory, but a fact.

Cells are the bricks of which the Metazoan edifice is constructed, but that edifice is also the manufactory for their construction, and the laboratory for their destruction and the working up again of a great portion of their material.

What wonder is it, therefore, that in the fluids, and on and in the tissues should be found protoplasm, which has not yet been formed into cells, or which has previously existed in that state?

The formative powers of protoplasm, and the distinction varying greatly in its width, between the formative and the formed material, are recognized by all biologists, and it is difficult to see what addition Dr. Beale brings to our previous knowledge.

Dr. Beale, in common with all other biologists, finds that a certain complex physical substance, occurring only in the organic world, possesses properties and performs movements not possessed or performed by other kinds of matter. In common with all other biologists, he is in the most absolute ignorance of the cause of these movements, but, instead of confessing that ignorance, he asserts that they can only be accounted for by assuming the existence of "some sort of supra-physical or vital power." The latter term is admissible as a title for what we cannot explain, but the former term involves an assumption unwarranted by anything within the range of our knowledge. The belief that every unexplained fact is "supra-physical" belongs to the mediæval stage of thought, and it is high time that it were banished from the beliefs and writings, as it is from the life and practice of the civilized portion of humanity.

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